FORMATION OF THE CHARPENTIER ILLUSION OF WEIGHT IN THE BLIND

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by

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I Problem

The space perception of the blind is not only interesting in itself but offer useful suggestions to the perception of the normal in general. The most impressive thing about the blind is that they can walk in the street, perceiving any obstacles there are, and the distance from and direction of them and that he can skilfully avoid them. Already in 1747, Diderot in France took notice of it, and explained it through some sensations. Since then, the perception of obstacles has most often been studied and its theories presented among the space perception of the blind. The most systematic and thoroughly executed research is perhaps that of K. M. Dallenbach of Cornell in 1944 to 1950[1]. However, the other sort of space perceptions of the blind has not yet been fully and experimentally studied.

Is the blind able to discriminate the large and the small box, through lifting them up successively, grasping the same size handle, without touching them directly with their fingers? Further, if it is possible to perceive the difference in size, is it possible through experimental procedure to make it impossible for him to do so?

In such problems we have been interested and to attack such problems experimentally, we used Charpentier illusion of weight. The Charpentier illusion appears only through visual perception. Without visual discrimination of the difference in size of two objects, the illusion cannot come out. If so, with the full blind the Charpentier illusion can not appear at all.

In 1897, J. F. Rice investigated the size-weight illusion of the blind with 2 sets of suggestion blocks of Seashore[2] and found the occurence of Ch. illusion, when the blind grasp the blocks with fingers and lift them up one by one. A. Peiser investigated in 1924 under the guidance of N. Ach about it in the two blind men of 37 and 38 years old respectively[3]. He found the illusion in them also, if they have perceived the size difference of two boxes tactually. Now, if the blind has tactually not perceived the difference of size, would the Charpentier illusion still come out? To test this is our first problem.

Our second problem is, if the Ch. illusion still appears without passing

his hand over the boxes, how he can perceive without visual and cutaneous perception the size difference of two objects, grasping just the same sized handles of them. To investigate the non-visual factors experimentally, we want to know whether we can let the Ch. illusion disappear in the blind. Through this procedure we would able to get knowledge about non-visual cues of size perception of the blind.

The third problem is the influence of experience upon the size discrimination through non-visual cues. Is there any difference about the occurrence of Ch. illusion between the congenital blind and the acquired blind ?

The forth problem is how the illusion is related to the duration of blindness.

The fifth and last problem is about the relation between the illusion and the intelligence. Is the Ch. illusion different according to the level of I. Q. of the blind ?

In order to investigate such problems we have undertook the following experiments.

II The First Experiment

In the first experiment we want to know whether the Ch. illusion comes out in the full blind also, who are not able to discriminate the size difference of things visually. If the illusion comes out, how is the difference of it between two cases: the one when the blind, grasping the handle, lifts up the boxes successively, and the one when he passes over two boxes with both hands and percieves size difference of them tactually, and then lifts the boxes up successively.

(A) The experimental procedure

To confirm the above mentioned problem, we have constructed three different experimental procedures and compared their results one with another.

Experimental procedure (a)

This procedure is the standard procedure. Either standard stimulus or 7 comparative stimuli are of the same sized, black, wooden boxes[4]. The boxes have the same sized handle in order to make it easy to grasp them and lift them up (Fig. 1).

Experimental procedure (b)

The (b) procedure is that to test the occurrence of the Ch. illusion. The size of the comparative stimuli is the same as those of the procedure of (a). The size of standard stimulus is on the contrary much larger than that of

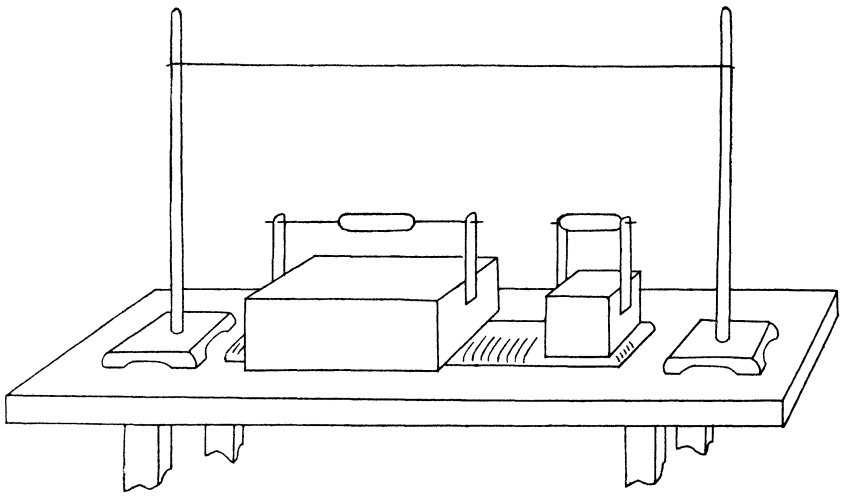


Fig. 1

procedure (a). This is the Ch. box. But its weight is the same as the standard stimulus of the procedure (a).

Experimental procedure (c)

This is the procedure to test the occurrence of Ch. illusion when the subject has known the difference in size through the touch sensation over the boxes. The standard stimulus as well as comparative stimulus is the same as those of the procedure (b). Before lifting two weights successively, the subject passes his fingers over both standard and comparative boxes thoroughly and slowly, so that he perceives the size difference through touch sensation completely.

The procedures (a) and (b) were carried out in the first experimental day. The procedure (c) in the second experiment day, that is, one or two days after the first experiment day.

(B) Stimulus and Instruments

(1) Comparative stimulus.

Seven $8.5 \times 8.5 \times 8.5$ cm wooden black boxes ; on which a wooden handle is fixed with 6 cm long aluminium fittings (see Fig. 1). Those weights are 675, 650, 625, 600, 575, 550 and 525 gr.[4]

(2) Standard stimulus.

There are two kinds of standard stimuli :

(a) A black wooden box in the same size of comparative stimulus. Its weight is 600 gr.

(b) Charpentier box.

A black wooden box in size of $23 \times 23 \times 9$ cm. Its weight is 600 gr. It has the same handle as the other boxes.

(3) Cushion

A cushion in the size of $47 \times 10.5 \times 1.5$ cm, which is filled with silk-wadding in order to prevent the noise when the weights are put down and to avoid the box being damaged.

(4) In the distance of 65 cm from each other, there are two 75 cm high poles on the 34 cm height from the table surface, a string is fixed to two poles, in order to make the height of lifting up movement constant.

(C) Method of Comparison

The weight of the two boxes is compared successively by the constant method. On the right side of the subject stands the standard stimulus, and on the left side the comparative stimulus, in the distance of 7 cm from each other. The manner of grasping the handle is alway the same. In accord with metronome sounds of 69 tact in a minute, the subject lifts up two boxes one by one. The comparative stimulus is presented disorderly. The subject lifts up first the standard, and then the comparative stimulus. As soon as he puts down the comparative stimulus he must report his judgement about the weight. The categories of judgement are "lighter", "a little lighter", "the same", "a little heavier" and "heavy". When the subject cannot feel the difference clearly, he may say he cannot tell.

Each time the experimenter takes the right hand of the subject, and brings his hand to the handle of box. In the same manner, the experimenter conducts the heights of lifting up. At this time the experimenter carefully avoid the fingers of the subject touching any other part of the box except the handle. The subject practised repeatedly the tempo of lifting up movement previously.

(D) Subject

The subjects were twenty-two Miyagi Prefectural Blind School pupils in Sendai, 13 being male and 9 female. They are 12-26 years old and from the 6-year-grade of elementary school up to the professional course. The congenital blind are 7 and the acquired blind 15. The duration of the blindness of the latter is 15-26 years. They are all full blind or the blind who is lacking the light sensation almost all. According to the Ohwaki's Block-Design test for the blind, their average IQ is 80.

III Results of the First Experiment

Does Charpentier illusion appear in the totally blind also? The answer to this question would be given from the results of our procedure (b). By making a comparison between the said results and those of the procedure (a), that is, from the difference between them, we can get the answer.

In the table I, we survey the results of the (a), (b) and (c) procedures: the table 2 shows the difference between them.

Table 1

Weight judgment of each subject

	Procedure A (standard st.)			Procedure B (Char. stim.)			Procedure C (direct touch)		
Subj.	h	e	l	h	e	l	h	e	l
No. 1	13	2	6	14	2	5	19	1	1
〃 2	7	10	4	12	7	2	16	4	1
〃 3	13	3	5	14	5	2	14	2	5
〃 4	12	3	6	11	4	6	18	1	2
〃 5	10	4	7	11	4	6	19	0	2
〃 6	9	5	7	13	5	3	15	4	2
〃 7	13	2	6	12	1	8	14	5	2
〃 8	7	5	9	16	5	0	11	3	7
〃 9	7	7	7	12	4	5	13	6	2
〃 10	12	4	5	11	5	5	9	8	4
〃 11	10	7	4	14	6	1	17	3	1
〃 12	8	6	7	14	6	1	18	3	0
〃 13	8	3	10	15	1	5	11	4	6
〃 14	8	4	9	12	3	6	12	4	5
〃 15	10	0	11	9	3	9	12	6	3
〃 16	15	1	5	18	2	1	20	1	0
〃 17	7	3	11	10	5	6	18	3	0
〃 18	7	4	10	10	4	7	11	6	4
〃 19	8	5	8	13	3	5	14	3	4
〃 20	12	1	8	12	1	8	20	0	1
〃 21	11	3	7	15	2	4	17	4	0
〃 22	3	7	11	12	5	4	16	0	5
Total	210	89	163	280	83	99	334	71	57

h=heavier e=the same (sometimes not clear) l=lighter

At first, let us see the results of the procedure A.

(1) On the average, the number of the judgement "heavier" is more

numerous than that of the "lighter". That is to say, the negative time error is seen in the blind also.

(2) In the individual subject, on the contrary, we can find such subjects as no. 8, 9, 13, 14, 15, 17, 18, 19 and 22, whose judgements have shown no negative time error. This is a remarkable matter. Especially, in two subjects, no. 9 and no. 19, the number of the judgement "heavier" is the same as that of the "lighter". Besides, in 3 subjects no. 8, 14 and 15, the number of the two judgements is nearly the same. These results seem to show that the perception of weight is much more exact than that of the seeing person.

Next, let us inspect the results of the procedure B, which is the answer to our question of whether Ch. illusion comes out in the totally blind, even if he has not touched the boxes directly with his fingers. Here we find the number of the judgement "heavier" is much more than that of the judgement "lighter". That is to say, the smaller boxes were judged heavier oftener than the big Charpentier box. The value of negative time error is much more

Table 2
Comparsion of procedure B with procedure A

Subj.	h	e	l	
No. 1	+ 1	0	− 1	
〃 2	+ 5	− 3	− 2	
〃 3	+ 1	+ 2	− 3	
〃 4	− 1	+ 1	0	×
〃 5	+ 1	0	− 1	
〃 6	+ 4	0	− 4	
〃 7	− 1	− 1	+ 2	×
〃 8	+ 9	0	− 9	
〃 9	+ 5	− 3	− 2	
〃 10	− 1	+ 1	0	×
〃 11	+ 4	− 1	− 3	
〃 12	+ 6	0	− 6	
〃 13	+ 7	− 2	− 5	
〃 14	+ 4	− 1	− 3	
〃 15	− 1	+ 3	− 2	×
〃 16	+ 3	− 1	− 4	
〃 17	+ 3	− 2	− 5	
〃 18	+ 3	0	− 3	
〃 19	+ 5	− 2	− 3	
〃 20	0	0	0	×
〃 21	+ 4	− 1	− 3	
〃 22	+ 9	− 2	− 7	

Table 3
Comparison of procedure C with procedure A

Subj.	h	e	l	
No. 1	+ 6	− 1	− 5	
〃 2	+ 9	− 6	− 3	
〃 3	+ 1	− 1	0	
〃 4	+ 6	− 2	− 4	
〃 5	+ 9	− 4	− 5	
〃 6	+ 6	− 1	− 5	
〃 7	+ 1	+ 3	− 4	
〃 8	+ 4	− 2	− 2	
〃 9	+ 6	− 1	− 5	
〃 10	− 3	+ 4	− 1	×
〃 11	+ 7	− 4	− 3	
〃 12	+10	− 3	− 7	
〃 13	+ 3	+ 1	− 4	
〃 14	+ 4	0	− 4	
〃 15	+ 2	+ 6	− 8	
〃 16	+ 5	0	− 5	
〃 17	+11	0	−11	
〃 18	+ 4	+ 2	− 6	
〃 19	+ 6	− 2	− 4	
〃 20	+ 8	− 1	− 7	
〃 21	+ 6	+ 1	− 7	
〃 22	+13	− 7	− 6	

than that in the procedure A (Table 2). However, the subjects no. 4, 7, 10, 15 and 20 are the exceptions. In them there is almost no difference between two procedures.

Besides, this occurrence of Ch. illusion is clear in 21 among 22 subjects. In the subjects no. 11, 12 and 16 the judgment "lighter" occurred only once. It has never occurred in the subject no. 8.

The results convince us that the blind have perceived in whatever way the difference of the size of boxes indirectly, though he has not directly passed their fingers over them.

In procedure (c), we let the subjects touch the two boxes thoroughly with the fingers of both their hands before he lifts up them one by one and compare their weights.

The results are seen in table 3.

The Charpentier illusion comes to appear very strongly, excepting only one subject no. 10. These results coincide with those of James F. Rice and A. Peiser.

Further, if we compare the results of the procedures (b) and (c), that is, table 2 and table 3, we find that the Ch. illusion occurrs more strongly in the process (c) than the process (b). It is because, although the blind can discriminate the difference in size without passing over the boxes with their fingers directly, he cannot so exactly perceive the difference than in the procedure (c), where he can pass his fingers directly and thoroughly over the boxes. Consequently the Ch. illusion must have occurred more strongly in the procedure (c) than in (b).

(c) Is there any difference in the occurrence of Ch. illusion between the congenital and the acquired blind? This problem has not yet been studied so far. Our congenitally blind subjects are seven, the acquired blind fifteen. The number of the subjects between two groups is unequal : moreover the subject number is not large enough. The experimental results are shown in table 4. The number in the table is an average of all the judgement categories per person.

If we count the difference between these procedures, we get Table 5.

It is remarkable that in the procedure (a), the congenital blind show

Table 4

procedure	A			B			C		
judg. / S	h	e	l	h	e	l	h	e	l
cong. $n=7$	8.4	4.3	8.3	12.4	3.6	5.0	13.6	3.4	4.0
acquired $n=15$	10.1	3.9	7.0	12.9	3.8	4.3	15.9	3.1	2.0

Table 5

procedure	B–A			C–A		
judg. / S	h	e	l	h	e	l
cong. $n=7$	+4.0	−0.7	−3.3	+5.2	−0.9	−4.3
acquired $n=15$	+2.8	−0.1	−2.7	+5.8	+0.8	−5.0

no time error : the number of the judgement "heavier" and that of "lighter" is almost equal. On the contrary, the acquired blind show time error just as the normal used to show it. These results seem to prove that the weight perception of the congenitally blind is superior to or more exact and stable than that of the acquired blind.

Through the difference between the result of procedures (b) and (a), we can acknowledge the occurrence of Ch. illusion in the blind, though he has not directly touched the boxes. Besides, we find more illusions in the congenitally blind than in the acquired blind. These results suggest that the congenitally blind perceive the size difference of two boxes more skilfully than the acquired blind.

In the procedure (c), the Ch. illusion occurred in the acquired blind a little more than in the congenitally blind. In the latter, the difference of the quantity of Ch. illusion between the procedures (b) and (c) is few. These results tend to tell us that in the congenitally blind there is only a little difference, whether he perceives the size difference directly and fully through touch sensation, or he has not directly touched them. That is to say, he can perceive the size difference of boxes already through the movement of lifting up and down only, without touching the boxes. In the experiment II, we want to explore more exactly the cues of his size-discrimination.

If we observe the acquired blind more exactly, there seems to be great difference of memory image of visual space between those who were blinded before four years old and who were blinded after four years old. Therefore we added the former to the congenitally blind and regarded the latter only

Table 6

The congenitally blind (who were blinded before 4 years old) and the acquired blind (who were blinded after 4 years old)

procedure	A			B			C		
judg. / S	h	e	l	h	e	l	h	e	l
cong. $n=13$	8.7	4.1	8.2	12.3	3.7	5.0	14.0	3.5	3.5
acquired $n=9$	10.8	3.9	6.3	13.3	3.8	3.9	16.8	2.9	1.3

Table 7

procedure	B-A			C-A		
S \ judg.	h	e	l	h	e	l
cong. $n=13$	+3.6	−0.4	−3.2	+5.3	−0.6	−4.7
acquired $n=9$	+2.5	−0.1	−2.4	+6.0	−1.0	−5.0

as the acquired blind. Then we compare the Ch. illusion of the two groups as following table 6 and 7.

If we compare the Ch. illusion of both the groups in the table, we find just the same tendency as we have found before. In consequence, we may say it is certain that the Ch. illusion occurrs in the congenitally blind more often and easily than in the acquired blind.

Nevertheless, the difference between the congenitally blind and the acquired blind is not great, but small. If we test the significance of the difference of the results of the 3 procedures, as well as that between congenitally blind and the acquired blind, we get the table 8.

Table 8

Analysis of variance according to table 4

source	sum of sq.	df.	mean sq.	F_0
diff. btw. procedure	2585.7	2	1292.8	24.58
diff. btw. cong. and acquired	296.8	1	296.8	5.64
error	105.2	2	52.6	—
total	2987.7	5	—	—

The difference between the procedures (a), (b) and (c) is significant on 1 % level, while that between the congenitally blind and the acquired blind is not significant on even 5 % level.

Spontaneous expressions and introspections of subjects and experimenter's observation

(1) Subject's spontaneous expressions and introspection

In the experiment about blind subjects, it is necessary, in addition to the numerical results of the experiment, to hear subjects' spontaneous expressions and introspections as well as to observe their behaviors. Through them we can often get information about the results and find hidden problems.

In the following, we will pick up some expressions and introspections of the subjects in the procedure (b).

Subj S.: He is in the first year class of middle school and congenitally

blind. The experimenter has taken care that he could not become aware of the size difference of the boxes. In spite of it, S said spontaneously, during the procedure (b) experiment as follows: "This one is heavier although it is smaller." And he inclined his head a few times strangely. "How do you know that there are a big box and a smaller one?", the experimenter asked him. Immediately he replied, "The larger one sounds as if it were empty, when it is put down, while the smaller one sounds as if it were filled with something. Therefore, I could understand the size difference."

It is a matter of course that the experimenter is unable to hear such a sound, much less to discriminate it.

Subj. K.: "She is a congenitally blind girl in the first class of middle school. She reported that she felt the larger one seemed light and flimsy, while smaller one seemed gently and calm. Therefore I could understand the size difference".

Subj. H.: He was blinded at the age of eight and now in the 2 nd year class of middle school. "I understood the bigger and the smaller one by the wind when I lifted up the boxes. When I lifted up the larger one a strong wind rose up, while when I lifted up the smaller one no wind rose. Besides, I could hear the sounds when I put down the boxes, as well as I could feel the difference of response in my hand when I put down the boxes."

Similar experience is very often reported, but we have found some other characteristic introspections as follows:

Subj. K.: "When I lifted up the larger one, I felt as if my hand got somewhat twisted."

This experience happened under the special condition that he did not grasp just the middle part of the handle.

Subj. A.: "When I lifted up the larger one, I felt that the sleeve band of my coat slightly touched the box, while the smaller one did not touch it, so that I had not such a feeling at the sleeve."

On the other hand, the length of the middle bar is of different length, to which the wooden handle of the same length is attached. There were a few subjects, who became aware of the different length of the bar through such touch sensation of coat.

Moreover, there were some subjects who could not explain it in words, although he had some discrimination about the size of the box in some way.

We have not found clear difference between the introspections of the congenitally blind and the acquired blind.

(2) Observations by the experimenter

We pick up some observations about the subjects' behaviors and attitudes during the experiment.

The blind in general seem to be not quite at ease, when he is not

touching something, so that they are incessantly moving their fingers and hands. Therefore the experimenter has taken care not to let his fingers touch the boxes.

When two boxes are of nearly the same weight and difficult to discriminate the difference, subject try to lift them up not with five fingers as instructed before, but with only one finger and compare them. This tendency was especially strong, when the subject assumed that this experiment was a test of his ability. To such a subject, to report "equal" or "not clear" seems his confession of inability for the task. In consequence, he endeavours to avoid such judgement. Therefore we have assured him often that this experiment is not a test of his ability, but of standard weight value of sensation.

Results of the First Experiment

(1) Charpentier illusion comes to occur in the totally blind also, if he touches the boxes with his fingers thoroughly and thereby he acknowledges the different volume of them.

(2) The blind are able to discriminate the size difference of boxes without direct touch sensation.

(3) The total blind seem to be able to discriminate the size of boxes through very faint hearing and very subtle, indirect touch sensation.

(4) The difference between the congenitally blind and the acquired blind was found about the negative time error of judgement.

(5) The difference between the congenitally blind and the acquired blind about the Ch. illusion is statistically not significant.

IV The Second Experiment

In the first experiment we have found that the Ch. illusion comes out in the full blind, who can perceive neither visually nor cutaneously the difference of boxes. From the subjects' introspections and experimenter's observations we assume that he seems to perceive the difference through hearing faint, under the threshold situated sounds and indirect subtle touching or muscular sensation.

In the second experiment,we want to ascertain;

(1) Whether the Ch. illusion does not come out, if we could eliminate experimentally such a faint audition and subtle, indirect touch sensation. Through such experimental procedure we want to confirm objectively the sensational ground of space perception of volume in the blind.

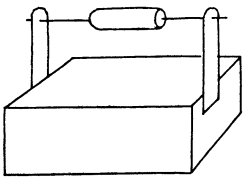
(2) In the first experiment, we were not able to discriminate clearly and significantly between the weight perception of congenitally blind and the acquired blind.

(3) We were not able to find any relation between I. Q. and the Ch. illusion. To confirm these problems we undertake the second experiment.

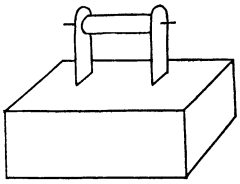
(4) To supply the results of the three exprimental procedures in the first experiment, we add the fourth experimental procedure, in which it is tested whether the Ch. illusion occurs through only verbal suggestion.

(A) Stimulus and Instruments

(1) The stimulus boxes are the same as those in the first experiment. But we improved the handle of the Ch. box (Fig. 2).



Ch. box in the 1st experiment



Ch. box in the 2nd experiment

Fig. 2

We cut the metal bar short till it was quite the same length of the comparative stimulus (Cf. Fig. 2), although the wooden handle itself remains the same length. Through it we avoided the occurrence of difference in touch sensation of subjects' sleeve bands, as an introspection of the subject in the

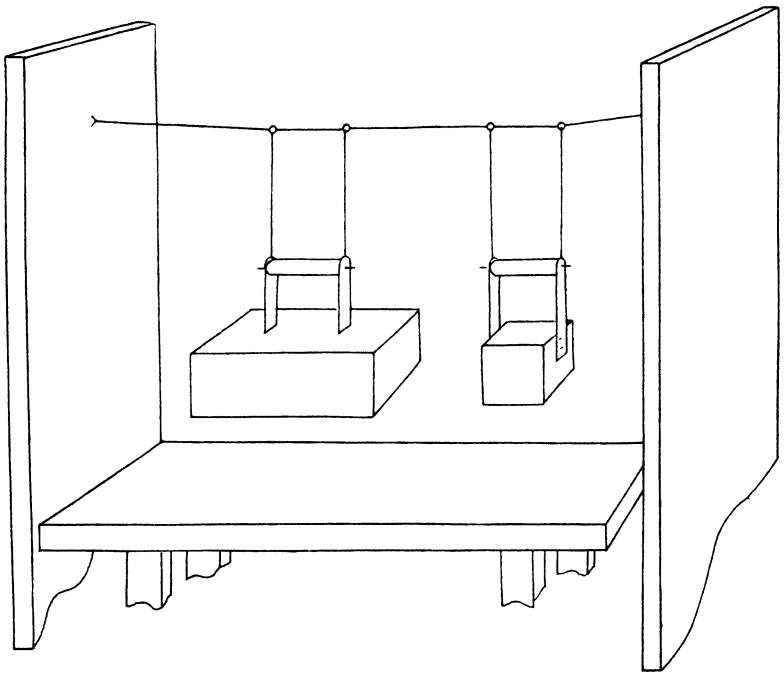


Fig. 3

first experiment suggested.

It is needless to say that the size and weight remains the same as those of the first experiment.

(2) We managed to exclude the auditory cue as well as indirect muscular sensation cue. As we were aware of them through introspection report, the cues seem to be existence of quite faint sounds and muscular sensation of their hands, when subjects put down the box on the cushion. Therefore we devised a plan to eliminate them. We stretched a wire between the left and the right wall at a height of the subject's chin. On the wire are attached four little hooks. On the other side we attached 16 cm strings in length at either end of the handle bar of each of the stimulus boxes (standard, comparative and Ch. boxes). Through it, the boxes are hung down by means of strings, after comparing each, instead of putting down on the cushion. Therefore it was no longer necessary to use the cushion filled with silk-waddling. In consequence, it causes no faint noises any longer because the boxes remain in the air when they are put down: nor does the subtle muscular sensation of resistence occur any longer.

(3) We stopped to use a metronome. Because we found in the first experiment that the sound of the instrument excites the curiosity of the blind su ject and disturbs the attention to compare the weights, or it was considerably diffcult for him to lift up and down the boxes in accord with the metronome sound. Therefore we did not use the metronome. Instead of it, the experimenter called out "One, two, three, four." And we let the subject's lifting movement start in accord with the calling. The tempo of calling remains almost the same as that of the metronome in the first experiment.

(B) The experimental procedure

The procedures (a), (b), and (c) are all the same as in the first experiment. Besides, we add the procedure (d) this time. Here we do not use Ch. box. The size of the standard and comparative boxes is the same. Nevertheless, we give such instruction that one box is larger than the other one.

In the first experiment, the standard stimulus was presented always on the right side of the subject. On the contrary, we present it now either on the right or on the left side at random, in order to avoid the space error.

In the first experiment day, we carried out the procedures (a) and (b), in the second day, (c) and (d).

(C) Subjects

By introducing the above-mentioned improvements on experimental

arrangements, we used pupils of the Blind School in Sendai as subjects at first, who participated in the first experiment. In this preparatory experiment we have found that the subject has still such an attitude or expectancy that there are perhaps big and small boxes as before. To avoid such an influence of mental attitude, we determined to carry out the second experiment on entirely new subjects of other school, who did not participate in the first experiment.

Subjects are now the pupils of the Iwate Prefectural Blind Shool in Morioka city, which is situated about 160 km away from Sendai. They are 13-29 years old, in the 6 th year grade of primary school up to the 1st year grade of the professional course: They are 13 boys and 8 girls, and 21 in all. Among them there are 6 congenitally blind; 7 who got blind at the age of two—four years; 5 who have been blind ten—sixteen years; 3 who have been blind sixteen years or more.

Table 8
Judgement of each subject

Procedure	A			B			C			D		
judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
no. 1	8	3	10	11	0	10	20	0	1	14	2	5
no. 2	10	3	8	8	4	9	13	3	5	14	2	5
no. 3	9	1	11	9	2	10	19	0	2	17	0	4
no. 4	10	2	9	9	1	11	16	2	3	16	1	4
no. 5	8	4	9	5	6	10	11	1	9	12	3	6
no. 6	9	4	8	8	5	8	15	2	4	14	3	4
no. 7	10	3	8	10	2	9	12	5	4	13	5	3
no. 8	8	4	9	12	3	6	19	2	0	14	3	4
no. 9	10	4	7	12	2	7	14	6	1	13	5	3
no. 10	9	3	9	12	2	7	20	1	0	10	5	6
no. 11	6	5	10	7	5	9	14	2	5	17	3	1
no. 12	8	4	9	8	2	11	10	1	10	9	4	8
no. 13	12	2	7	8	6	7	11	1	9	9	2	10
no. 14	11	1	9	8	1	12	16	3	2	16	2	3
no. 15	9	3	9	7	3	11	14	4	3	13	2	6
no. 16	10	0	11	8	2	11	16	2	3	10	4	7
no. 17	12	0	9	13	0	8	17	0	4	13	0	8
no. 18	12	2	7	13	6	2	16	2	3	15	2	4
no. 19	13	1	7	11	3	7	16	0	5	13	0	8
no. 20	11	3	7	13	1	7	16	4	1	15	4	2
no. 21	15	5	1	2	7	12	11	9	1	11	8	2
total	210	57	174	194	63	184	316	50	75	278	60	103

Their average I.Q. is 90.0, 10 over I.Q. 100; 11 below I.Q. 100. The I. Q. is measured by Ohwaki Intelligence Test for the blind. The average I. Q. 90 is a little higher than that of Sendai blind subjects. They are all totally blind, excepting two. They are living in the dormitory. The experiment was carried out in 28-31, Oct., 1956.

V. Results of the Second Experiment.

(a) The comparison judgement of every subject is as shown in table 8. The average number of every category of judgement per person is as shown in Table 9.

Table 9

procedure	A			B			C			D		
judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
n=21	10.0	2.7	8.3	9.2	3.0	8.8	15.0	2.4	3.6	13.2	2.9	4.8

The differences of each experimental procedures are as table 10.

Table 10

procedure	B–A			C–A			D–A		
judg. / S	h	e	l	h	e	l	h	e	l
n=21	−0.8	+0.3	+0.5	+5.0	−0.3	−4.7	+3.2	+0.2	−3.4

As we can see in tables 9 and 10, there is no large difference between the procedures (a) and (b). That is to say, in the comparison of big Ch. box with small boxes (procedure (b)), it produced no Ch. illusion. In other words, through avoidance of faint, subliminal noise and light resistance sensation of hand against cushion, we have succeeded in eliminating the occurrence of Ch. illusion in the blind. From this result it became clear, that the occurrence of Ch. illusion about the different size of boxes without directly grasping or touching the boxes, is based on the discriminative perception between the big and the small box through the subliminal auditory sensation as well as quite slight muscular sensation.

On the contrary, in the procedure (c), the judgement "heavier" increases overwhelmingly and the judgement "lighter" decreased much. That is to say, the Ch. illusion was caused through the direct touch sensation on the two boxes by turns, as it was in the procedure (c) in the first experiment.

In the procedure (d), where the boxes are all of the same size, but the

experimenter suggested verbally that the one is larger than the other, the Ch. illusion came out considerably strong.

Through all procedures the judgement "equal" is varied only ±0.3, that is, almost constant. This tendency is nearly the same as in the first experiment.

Relation between the Ch. illusion and the blinded age

In terms of the blinded age, we classify our subjects into two groups. The first group is the congenitally blind and those who were blinded after birth till four years old. They are 13. The second group is those who are blinded after ten years old. They are 8. Now, let us compare their weight judgements, which are shown in the tables 11 and 12.

Table 11

procedure	A			B			C			D		
judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
Group I	9.2	2.9	8.9	8.8	3.2	9.0	14.7	2.3	4.0	12.8	3.2	5.0
Group II	11.4	2.4	7.2	10.0	2.8	8.2	15.6	2.5	2.9	13.9	2.4	4.7

Table 12

procedure	B−A			C−A			D−A		
judg. / S	h	e	l	h	e	l	h	e	l
Group I	−0.4	+0.3	+0.1	+5.5	−0.6	−4.9	+3.6	+0.3	−3.9
Group II	−1.4	+0.4	+1.0	+4.2	+0.1	−4.3	+2.5	0	−2.5

The perception of weight is very similar in general between the two groups, especially in the procedures (c) and (d). But in the procedure (a), the first group shows no time error, while the second group does. These results are quite consistent with the results of the first experiment. In the procedure (b), the first group subjects show no time error, either. That is to say, the Ch. illusion came out no longer. On the contrary, the second group shows time error. This time error is a little smaller than that in the procedure (a), so that we cannot regard it as the effect of Ch. illusion, but the effect of time error. The effect of Ch. illusion is remarkably apparent in the procedure (c), in the first group as well as in the second group. The statistical significance of difference value, we analysed as Table 13.

Therefore we may say that there is significant difference in 5 %level between (a), (b), (c) and (d) procedures. On the contrary, between the conge-

Table 13

Analysis of Variance according to table

source	sum of sq.	df.	mean sq.	F_0
diff. btw procedure	2766.5	3	922.17	20.04
diff. btw. cong. and acquired	371.5	1	371.50	8.06
error	138.0	3	46.00	—
total	3275.0	7	—	—

nitally blind and the acquired blind, we cannot find significant difference.

From the result of procedure (a), we find the weight perception of the first group is more exact and stable, while that of the second group is inexact and unstable. The acquired blind, especially those who were blinded after 15 years old, are erroneous in the perception of weight difference which is clear from the comparison of their judgement and objective weight.

We attempted to classify the subjects more minutely in respect to the blinded age: we classify them into four groups as follows;

the 1 st group·····congenitally blind····· 6
the 2nd group·····blinded in the second-fourth age·····7
the 3 rd group·····blinded in tenth-fifteenth age ·····4
the 4 th group·····blinded in sixteenth age and afterwards·····4

Then we get such a difference as in the table 14.

Table 14

procedure	A			B			C			D		
Judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
Group I	9.8	2.5	8.7	10.2	2.7	8.1	16.5	2.2	2.3	13.2	2.8	5.0
Group II	8.6	3.3	9.1	7.6	3.6	9.8	13.1	2.4	5.5	12.6	3.4	5.0
Group III	10.0	2.0	9.0	10.3	1.3	9.4	16.4	1.3	3.3	14.3	1.3	5.4
Group IV	12.8	2.8	5.4	9.7	4.3	7.0	14.7	3.8	2.5	13.5	3.5	4.0

Table 15

procedure	B−A			C−A			D−A		
Judg. / S	h	e	l	h	e	l	h	e	l
Group I	+0.4	+0.2	−0.6	+6.7	−0.3	−6.4	+3.4	+0.3	−3.7
Group II	−1.0	+0.3	+0.7	+4.5	−0.9	−3.6	+4.0	+0.1	−4.1
Group III	+0.3	−0.7	+0.4	+6.4	−0.7	−5.7	+4.3	−0.7	−3.6
Group IV	−3.0	+1.5	+1.5	+1.9	+1.0	−2.9	+0.7	+0.7	−1.4

If we classify those who were blinded young and those who were blinded

less young and acquired blinded more closely into the above groups, it becomes clear that there is scarcely any difference between the first, the second and the third group. On the contrary, the fourth group, e. g., those who were blinded at 16 and afterwards, indicates considerable difference to the first three groups. They have 7.4 errors on an average in the procedure (a) already. Consequently, in the procedure (c), when they perceived the size difference thoroughly through direct touch, the Ch. illusion arrives at only a little value. As we may find in table 15, the same is true of the procedure (d). When we examine their judgements fully, we find their weight perception inexact and incorrect. They judged often erroniously about the comparison of 600 gr. and 525 gr., which nobody has erred in the groups of 1, 2 and 3. As such suject as no. 21, there is so exact subject who has judged in quite contrary between the procedures (a) and (b). Therefore it is not safe, only through the statistical analysis, to judge the difference between congenitally blind and the acquired blind. If we contrast the typically congenitally blind with the typically acquired blind as those of group 4, we may express as follows: (1) The acquired blind are remarkably inferior in the perception of weight difference in comparison to the congenitally blind. Particularly the latter are inferior in the difference perception of lighter weight. (2) In consequence, if we estimate the illusion quantity on the standard of the procedure (a), the acquired blind come to the result of few illusion in the procedures (c) and (d).

Relation between Ch. illusion and period of blindness

Next, let us classify the subjects in respect to the duration of blindness in three groups as follows. Does the duration of blindness have effect on the perception of weight?

	period of blindness
the 1 st group·····	over 10 years·····13
the 2 nd group ·····	5 to 10 years ····· 3
the 3 rd group ·····	less than 5 years ····· 5

Then we get table 16 and 17.

Table 16

procedure	A			B			C			D		
Judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
Group I	9.2	2.8	9.0	8.8	3.1	9.1	14.5	2.4	4.1	12.8	3.1	5.1
Group II	9.7	3.0	8.3	10.6	3.7	6.7	17.0	1.3	2.7	14.3	2.3	4.4
Group III	12.2	2.2	6.6	9.6	2.4	9.0	15.2	3.0	2.8	13.6	2.6	4.8

Table 17

procedure	B−A			C−A			D−A		
Judg. / S	h	e	l	h	e	l	h	e	l
Group I	−0.4	+0.3	+0.1	+5.3	−0.4	−4.9	+3.6	+0.3	−3.9
Group II	+0.9	+0.7	−1.6	+7.3	−1.7	−5.9	+4.6	−0.7	−3.9
Group III	−2.6	+0.2	+2.4	+3.0	+0.8	−3.8	+1.4	+0.4	−1.8

We are sorry that the second and the third group are only small in number. The difference between the 3 groups have, contrary to our expectations, almost the same tendency as we saw in the classified groups with respect to the blinded age. Between the 3 groups there is in general some similar tendency : especially they are very close in the procedures (c) and (d). The first group shows no time error in the procedures (a) and (b). Every subject in the 3 groups have uniformly shown no Ch. illusion in the procedure (b).

Then let us pick up typical 3 subjects in each group ; in one group, the duration of blindness is very long, while in the other group it's duration is very short. We have selected 3 subjects who have been blind over 18 years. On the other side, we have selected 3 subjects, who have been blind less than 3 years.

Table 18

procedure	A			B			C			D		
Judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
Group I	9.0	2.4	9.6	9.3	2.4	9.3	17.6	1.7	1.7	13.3	2.4	5.3
Group II	13.0	3.0	5.0	8.7	3.6	8.7	14.3	4.3	2.4	13.0	4.0	4.0

Table 19

procedure	B−A			C−A			D−A		
Judg. / S	h	e	l	h	e	l	h	e	l
Group I	+0.3	0	−0.3	+8.6	−0.7	−7.9	−4.3	0	−4.3
Group II	−4.3	+0.6	+3.7	+1.3	+1.3	−2.6	0	+1.0	−1.0

In general, we observe the same tendency as in the groups above mentioned. In the procedure (c), the 2nd group has smaller effect of Ch. illusion than the Ist group. We suspect that it has become from the shorter experience of touch sensation, so that they can not yet so effectively use the touch sensation as those who have over 18 years of experience of this sensation in the group I.

Next, let us try further to observe the relation between the blinded age, period of blindness and the development of weight perception.

We pick up 3 typical subjects as follows:

			period of blindness
Subject T :	blinded at 13 years old	: 15 years old now	: 2 years
Subject E :	blinded at 23 ** **	: 25 ** ** **	: 2 years
Subject N :	blinded at 19 ** **	: 28 ** ** **	: 9 years

If we compare their weight perception, so we get the table 20.

Table 20

procedure	A			B			C			D		
Judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
T. K.	10	2	9	9	1	11	16	2	3	16	1	4
E. O.	15	5	1	2	7	12	11	9	1	11	8	2
N. S.	12	2	7	13	6	2	16	2	3	15	2	4

From the table, it is clear there is large difference of weight perception between subjects T and E, notwithstanding the sameness of the length of blindness. Subj. T's judgement is more exact and stable, while subj. E's judgement is inexact and unstable. Besides he has many such judgements as "the same" or "not clear". It is because, we assume, that subj. T was blinded as early as in the 13th age, while subj. E was blinded in the 23rd age. Consequently, the earliness of the age when he was blinded, seems more important for the development of weight perception than the length of blindness. Subj. N is a girl, who was blinded at the 19th age; she has therefore 9 years' duration of blindness. In spite of it, her weight perception is not so exact and stable. She could get only few correct judgements about the lighter weights. Although the sample is too small, we suspect that, whether the blindness occurs before about 13 years old, or after that age, there is a great difference about the development of compensatory sensitiveness of the other sensation. In comparison with the age of blindness, the length of it seems to be not so important a factor.

I Q and Charpentier illusion

According to the opinion of C. Spearman[5] there is nearly +1.00 correlation between the genral intelligence and discrimination of sensation. The general factor is the ground of sense discrimination. Yet, there are several authors who does not acknowledge the the theory of the coincidence of these two activities. We want now to test the relation between I Q and Ch. illusion.

According to IQ, we classify the subjects into 3 groups, after the intelligence

test of Ohwaki system (touch block design test), the average of IQ of our subjects was 90. 0. Therefore, we adopt 90.0 as the middle position and classify the subjects as follows:

group 1·····below 70.0 $n=6$
group 2·····71.0 to 110.0 $n=7$
group 3·····over 111.0 $n=7$

The discrimination of weight difference of these 3 groups is as follows.

Table 21

procedure	A			B			C			D		
Judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
Group I	10.0	3.4	7.6	8.3	3.4	9.3	14.0	2.9	4.1	12.3	3.6	5.1
Group II	10.6	2.7	7.7	11.0	3.3	6.7	15.3	3.3	2.4	14.3	2.7	4.0
Group III	9.8	2.2	9.0	9.5	2.6	8.9	15.8	1.7	3.5	13.7	2.3	5.0

Table 22

procedure	B−A			C−A			D−A		
Judg. / S	h	e	l	h	e	l	h	e	l
Group I	−0.2	0.0	+0.2	+5.6	−0.8	−48.0	+3.5	−0.2	−3.3
Group II	−0.5	+0.5	0.0	+4.1	−0.6	−3.5	+3.1	−0.5	−2.6
Group III	+0.3	0.0	−0.3	+6.9	−0.3	−6.6	+4.3	+0.6	−4.9

Except the procedure(a), there are few differences in weight judgement among three groups. If we analyse the distribution, we get table 23.

Table 23
Analysis of Variance according to table 22

source	sum of sq.	df.	mean sq.	F_0
diff. btw. procedure	5237.6	3	1779.20	41.96
I. Q.	9.9	2	4.95	0.12
error	254.5	6	42.41	
total	5502.0	11		

we cannot find significant difference between the three different I. Q. groups.

Then, let us pick up the highest I. Q. subject and the lowest I. Q. subject.

S_I = the highest I. Q. S.; I. Q. 136; blind period 13 years; age 13

S_{II} = the lowest I. Q. S.; I. Q. 51; blind period 11 years; age 14

The judgement of the subject I shows little variance in the procedures (a) and (b), while the subject II shows it remarkably. Moreover the judgment "equal" is very often in the subject II, while it is very rare in the subject

Table 24

procedure	A			B			C			D		
Judg. / S	h	e	l	h	e	l	h	e	l	h	e	l
I	9	1	11	9	2	10	19	0	2	17	0	4
II	8	4	9	5	6	10	11	1	9	12	3	6

Table 25

procedure	B−A			C−A			D−A		
Judg. / S	h	e	l	h	e	l	h	e	l
I	0	+1	−1	+10	−1	−9	+8	−1	−7
II	−3	+2	+1	+ 3	−3	0	+4	−1	−3

I. The Ch. illusion in the procedures (c) and (d) occurs very often in the subject I, while it occurs less often in the subject II. In such extreme difference of I. Q., we can find a remarkable difference in discrimination of weight also. Therefore, in such cases, we are able to say that the Separman's theory is adequate.

Resultes of the Second Experiment

(1) From the results of the first experiment, we were able to assume that the blind can perceive the difference between big objects and small ones without directly grasping or stroking the objects : therefore Ch. illusion comes out in him. He seems to discriminate the size of two objects through the sensation of subliminal sounds, and faint muscular sensation of resistance, when he puts down the objects upon the cushion.

Now we have constructed a new box and instruments through which such two sensations may not come out. Besides as subjects we adopted quite new subjects of the other blind school about 60 km. away from Sendai. The results of this experiment (procedure (b)) shows that the Ch. illusion occurs no longer.

(2) The difference between the congenitally blind and the acquired blind about the Ch. illusion is statistically not significant. But those who were blinded at the age of 16 or afterwards, are clearly inferior in the discrimination of weight.

(3) The blinded age is a more important factor for the weight perception than the duration of blindness.

(4) The relation between the level of intelligence and perception of weight is statistically not significant. Yet if we pick up an extremely high I. Q.

subject, and an extremely low I. Q. subject and compare them, then we find remarkable difference of discrimination ability.

VI Considerations

(1) Since G. Th. Fechner, Charpentier and G. E. Müller[6], many experimental researches have been carried out on the Ch. illusion of weight. As theories to explain the illusion, we find (a) Müller-Schumann theory of muscular sensation of lifting up speed, (b) expecting image theory of Seashore and Marbe[7], (c) Friedländer's mental set theory[8], (d) Usnadze's theory of visual perception of difference[9]. We believe that the visual perception about the size difference is the most strong factor for the occurrence of Ch. illusion. Therefore Usnadze has expected that Ch. illusion would not appear, if the normal is closing his eyes or if he is blind. However, in the blind, Ch. illusion occurs if he perceives and knows the size difference of two objects through touch or muscular sensation of grasping. This phenomenon is observed already by J. F. Rice and A. Peiser. We have observed it also in the first experiment (procedure (c)). Far from that, without directly touching on the big objects and small ones, the Ch. illusion occurs in the blind (procedure (b)), That is to say, he can discriminate the size of two objects without directly touching it, but only lifting them up successively, grasping only the same size handle of them.

Through the second experiment, we have ascertained that his size discrimination is possible through the audition of subliminal sounds and faint muscular sensation of resistance. It is certain, because if we so arrange the apparatus that these sensations do not occur, the Ch. illusion do not come out. The normal can never hear the sounds, much less the difference of sounds, when he puts a 600 gr. box on a cushion. No audiometer can measure such loudness of sound. The blind are able to feel such subliminal stimuli and through it discriminate the volume of objects. The subliminal stimulation is recently attracting attention in America on occasion of recent advertising demonstration. J. V. McConnell et al. gave an excellent overview on the former experimental researches on it[10]. But we think the blind and the deaf-mutes are feeling such subliminal stimuli much more than the normal. Audition, touch, muscular sensation of the blind and vibration sensation of the deaf-mutes are very often such sensation of subliminal stimuli.

On the other hand, sensations of subliminal stimuli of the blind mean the wonderful development of his sense organs. This proves the immeasurable potential possibility of development of our sense-organ's sensibility, if it is trained properly and from young age.

(2) The blind, especially the congenitally blind are correct in discriminating lifted up weights. In his comparison come out almost no negative time error. In consequence the negative time error in successive comparison is not always a general phenomenon. The normal, whose comparison ability is not good, the time error occurs in general. But the congenitally blind, whose discriminating ability of weight is remarkably sharp, the time error does not occur. From these results we must regard that the trace theory of negative time error by W. Köhler and K. Koffka is, though it is an elaborate theory, not so generally adequate.[11]

(3) The blinded age is a more important factor for the occurrence of Ch. illusion of weight than the duration of blindness. Especially the group, who was blinded in 16 years old or afterwards, is very inferior in the weight perception. These results suggest that the development of sensori-motor learning, especially subliminal sensation learning, is very slow in the 16 years old and afterwards. The weight perception in Ch. illusion belongs to the so-called "early learning" of D. O. Hebb.[12] There seems to be limitation on age for such sort of learning. According to the experimental results of Sonoko Ohwaki, the Ch. illusion does not appear in three years old (chronological age), but in 4 to 5 years old (mental age) the ability developes suddenly and remarkably.[13] This finding seems to correspond well to our results.

On the other side, our results seem to suggest that the subliminal perception becomes possible when one is blinded before about 10 years old, so that he can discriminate the weight difference almost nearly as the congenitally blind, if the blindness duration is not too short.

(4) The relation between the level of intelligence and the quantity of Ch. illusion is not statistically significant, if we compare the groups of different intelligence level as a group. However, if we pick up a subject of extremely superior I. Q. 136 and a subject of extremely low I. Q. 51, and compare their Ch. illusion, we find a clear difference in the procedures (c) and (d). In weight comparison after the touch perception of two boxes the Ch. illusion of the former is much larger than that of the latter (procedure (c)). Again, in weight comparison after the information about the size difference through instruction, the difference of Ch. illusion is observed between them. This difference suggests that the extreme difference of intelligence level influences the subliminal sensation.

VII Summary

(a) Even the blind who have no visual sensation show Ch. illusion in the successive comparison of two weights, if he perceives and knows beforehand

the size difference between two objects through touch and muscular sensation. This fact was found by J. F. Rice and A. Peiser. We have found it in the first experiment (procedure (c)). Moreover, without directly grasping or stroking two boxes, many blinds show Ch. illusion. We found it in the procedure (b). Through the observation of subject's behavior and verbal report of his introspection, we could suspect the sensory ground of it. It seems to be possible for him to perceive the size difference through the difference of faint muscular sensation when the object was put down on a cushion, and audition of noise, which is imperceptible for the normal.

(b) Now we wanted to ascertain whether this is true or not. We have improved the weight box as well as the experimental apparatus and arrangement. Quite new subjects were used who are living about 60 km. away from Sendai. The results of this experiment (procedure (b)) shows, as we expected, that Ch. illusion does not occur.

(c) In the congenitally blind, almost no negative time error comes out, when he compares successively the two weights of the same volume box. But on the contrary, the acquired blind show the negative time error. From this we know that the weight perception of almost all of the congenitally blind are very exact. On the other hand the field theroy of trace of W. Köhler, K. Koffka is not so generally adequate.

(d) As for the relation between blinded age and Ch. illusion, we can not find it statistically significant. However, the acquired blind who were blinded at the age of 16 or afterwards, is remarkably inexact in weight perception, especially about the perception of lighter weight. On the other hand among the congenitally blind, we have found the one who judged remarkably correct.

(e) In comparison with the blinded age, the blinded duration has not so strong an influence upon the Ch. illusion, if it is not too short.

(f) The relation between Intelligence Quotient (I. Q.) and Ch. illusion is not significant statistically. However, if we pick up a subject who has extremely high I. Q. (136) on the one hand and a subject who has extremely low I. Q. (51) on the other hand, while their chronological age is about the same (13 and 14 years old), and their duration of blindness is also about the same (13 and 11 years), and if we compare their Ch. illusion, we find remarkable difference. The latter subject showed only a little Ch. illusion when he was able to touch two boxes (procedure (c)) or he did not get so much Ch. illusion as the former when he was informed verbally about the size difference.

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Résumé

(a) Dans la comparaison successive de deux poids, l'aveugle même qui n'a pas la sensation visuelle montre l'illusion de Charpentier, quand il aperçoit et sait à l'avance la différence de la grandeur entre deux objets par la sensation de toucher ou la sensation musculaire. Ce fait a été dècouvert par J. F. Rice et A. Peiser. Nous l'avons trouvé dans la première expérince (procédé (c)). D'ailleurs, beaucoup d'aveugles montrent l'illusion de Ch. en dehors de saisir ou toucher deux boites directement. Nous l'avons trouvé dans le procédé (b). Par l'observation des comportements des sujet et des procès-verbaux de leur introspections,nous avons pu reconnaître son fondement sensoire. Il est peut-être possible que l'aveugle perçoive la différence de la

grandeur par la différence de la sensation musculaire plus faible quand l'objet a été déposé sur le coussin, et par l'audition de bruit, que nous, les normaux, ne le pouvons apercevoir.

(b) Or, nous avons voulu assurer si c'est vrai ou faux. Nous avons amélioré la boite aussi que l'instrument expérimental et son arrangement. Des sujets tout à fait nouveaux ont été employés, qui demeuraient à 60 km loin de Sendai. Les résultats de cette expérience (procédé (b)) indiquent que l'illusion de Ch. ne s'est plus présenté, comme nous pouvait s'y attendre.

(c) Quant aux aveugles congénitaux, l'erreur de temps négatif ne s'est guère présenté, quand ils ont comparé deux poids du même volume. Mais, au contraire, l'erreur de temps négatif s'est présenté dans les cas des aveugles acquis. Delà nous avons su que la perception du poids des aveugles congénitaux a étè très exacte presque sans exception. Par contre, la thèorie du champ de la trace après W. Köhler et K. Koffka n'a pas été adéquate ainsi généralement.

(d) Quant à la relation entre le délai depuis qu'un sujet a perdu sa vision et l'apparition de l'illusion de Ch., nous ne pouvons trouver la signification d'une manière satisfaisante. Cependant, des aveugles acquis, qui ont été aveugles à l'age de 16 ans ou plus âgés, étaient inexacts remarquablement en perception du poids, surtout chez la perception du poids plus léger. De l'autre côté, parmi des aveugles congénitaux, nous avons trouvé un sujet qui a jugé correctement.

(e) Chez la comparaison avec l'âge de l'aveuglement, la durée de l'aveuglement n'a pas l'influence trés forte sur l'illusion de Ch.

(f) La relation entre le Quotient d'Intelligence (Q.I.) et l'illusion de Ch. n'a pas été significative d'une manière satisfaisante. Cependant, quand nous prenons un sujet qui est plus intelligent au niveau de 136 Q. I, de l'autre côté, un sujet qui est moins intelligent au niveau de 51 Q. I., et quand nous comparons leur quantité de l'illusion de Ch., nous trouvons une différence remarquable, bien qu'ils aient un âge chronologique presque identique (sont agès de 13 et 14 ans), et que leur duration de l'aveuglement est aussi presque identique (13 année et 11 année). Ce sujet-ci ne montre qu'un peu d'illusion quand il a pu toucher deux boîtes (procédé (c)) ou son illusion a été moins grande que celle de celui-là quand il a reçu une information verbale à l'égard de la différence de la grandeur.

Zusammenfassung

(a) Selbst die Blinden, die keine visuelle Empfindung haben, zeigen Charpentier Täuschung bei der sukzessiven Vergleichung zweier Gewichte, wenn sie vorher durch Tast-und muskuläre Empfindungen den Grössenunterschied

zwischen zwei Gegenständen wahrnehmen und erkennen. Diese Tatsache war schon von J. F. Rice (1897) und A. Peiser (1924) gefunden. Ohne aber weiter zwei Kasten, einen grossn und einen kleinen unmittelbar zu ergreifen oder darüber streicheln, zeigen viele Blinde auch Ch. Täuschung. Das haben wir in der Versuchsanordnung (b) gefunden. Durch die Beobachtung über das Vp'sche Verhalten und durch sprachliche Nachrichten ihrer Selbstbeobachtung, konnten wir grundlegende Empfindungen vermuten. Für die Blinden ist es wahrscheinlich möglich, durch Differenz von ganz schwachen muskulären Empfindungen, als die Kasten auf den Kissen heruntergebracht werden und durch Gehörsempfindungen von solchen schwachen Geräuschen, welche für uns Normalen nicht zu wahrnehmen sind.

(b) Nun wollen wir feststellen, ob diese Vermutung wahr ist. Wir haben die Gewichtkasten, experimentelle Apparatur und Anordnung verbessert. Ganz neue Vp waren gebraucht, die ungefähr 60 km entfernt von Sendai wohnen und eine andere Schule besuchen. Die Resultate dieser zweiten Versuche (Versuchsanordnung (b)) zeigen, dass, wie wir vorausgenommen haben, Ch. Täuschung nicht mehr entsteht.

(c) Bei den Blinden von Geburt waren die negativen Zeitfehler kaum herausgekommen, als sie nacheinander zwei Gewichte von ganz gleichgrossen Kasten verglichen. Im Gegenteil aber die erworben Blinden kommt die negativen Zeitfehler. Von dieser Tatsache aus wissend wir, dass die Gewichtswahrnehmung von beinahe allen Blindgeborenen scharf und richtig ist. Auf der anderen Seite ist die Spurenfeld-theorie von W. Köhler und K. Koffka nicht so allgemeingültig.

(d) Dem Verhältnisse zwischen dem verblindeten Alter und Ch. Täuschung können wir statistisch keine Bedeutung beilegen. Jedoch sind die erworben Blinden,die im Alter von 16 oder noch später verblindet sind, ausserordentlich unrichtig und unsicher in der Gewichtswahrnehmung, besonders in derjenigen von leichteren Gewichten. Auf der anderen Seite, haben wir unter den Blindgeborenen eine Person gefunden, deren Gewichtsunterschied ausserordentlich richtig war.

(e) Im Vergleich mit dem verblindeten Alter übt die verblindete Dauer keinen grossen Einfluss auf die Ch. Täuschung aus.

(f) Das Verhältnis zwischen Intelligenz-Quotient (I.Q.) und Ch. Täuschung ist statistisch nicht bedeutsam. Wenn wir aber eine Vp. der ausserordentlich hohen I.Q. (136) auf der einen Seite und eine Vp der ausserordentlich tiefen I.Q. (51) auf der anderen Seite haben während ihr chronologisches Alter ungefähr dasselbe ist und ihre Blindendauer auch ungefähr dieselbe ist, und wenn wir sie miteinander vergleichen, so finden wir da einen grossen Unterschied. Die letztere Vp zeigt nur in geringem Grade Ch. Täuschung, wenn sie über

zwei Kasten genug tastet können (Versuchsanordnung (c)), oder sie zeigt nicht so viel Ch Täuschung, als die erstere Vp, wenn ihr sprachlich von der Grössendifferenz Kunde gegeben wird.